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ABSTRACT

This study examined university technology transfer in Maryland in terms of three issues: (1) the economic impact of university technology transfer; (2) a comparison of the technology transfer effort of University of Maryland System (UMS) institutions with other regional and "best practice" institutions; and (3) the technology transfer policies and guidelines of UMS institutions compared to other regional and "best practice" institutions. The study involved review of economics and public policy literature on technology transfer and interviews with technology transfer professionals. It was found that UMS institutions are competitive with regional and best practice universities in terms of research inputs, and make an above average effort to promote technology transfer. In terms of technology commercialization outcomes, or success in commercializing technology, UMS institutions were at the lower end of the 16 universities studied despite UMS being ranked third in the number of technologies commercialized. Fifteen tables of data are included along with matrices of institutional mission and technology goals. A copy of the interview guide is appended. (JLS)

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The Jacob *france* Center

Benchmarking the Economic Impact and Effectiveness of University Technology Transfer in Maryland

Prepared for
The University of Maryland System
and
The Maryland Department of Business
and Economic Development

by

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February 28, 1996

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Executive Summary

High technology industries are an important part of the Maryland economy, employing nearly 8% of the workforce and paying wages 66% above the private sector average. Numerous studies of high technology development have found that the transfer of university research and technology to the private sector is a critical factor in supporting high technology development. There are an estimated $13 billion in product sales and more than 100,000 jobs associated with transferred university technology nationally, and $1 billion in sales and 8,350 jobs in the Middle Atlantic region.

Maryland is a national leader in research and development (R&D). The state is one of the top five states in terms of per capita total R&D, federally funded R&D, federally performed R&D and university R&D. However, Maryland lags the national average in commercializing R&D, with per capita patents issued being below the national average. Promoting university technology transfer is an important means of improving the commercialization of technology in the state. Improving technology commercialization through technology transfer has, in fact, been identified as a critical action item in the state's economic development strategic plan.

In comparing the technology transfer effort at UMS institutions to other universities, UMS institutions are competitive to regional and best practice universities, in terms of research inputs, and place an above average effort on promoting technology transfer. In terms of technology commercialization outcomes, or success in commercializing technology, UMS institutions were at the lower end of the 16 universities studied in the value of technologies commercialized, despite UMCP being ranked 3rd in the number of technologies commercialized. In comparing the technology transfer policies and guidelines of UMS institutions to other universities, UMS institutions generally fall within the parameters of our sample in every category. However, many universities are liberalizing their technology transfer rules, especially in the area of conflict of interest guidelines, in order to support and promote technology commercialization.

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1.0 INTRODUCTION

The University of Maryland System (UMS) and the Maryland Department of Business and Economic Development (DBED) commissioned the Jacob France Center of the Merrick School of Business at the University of Baltimore (the France Center) to prepare a report on the effectiveness and economic impact of university technology transfer in Maryland. This report analyzes three key issues:

1. What is the economic impact of university technology transfer?
2. How does the technology transfer effort of UMS institutions compare to other regional and "best practice" institutions?
3. How do the technology transfer policies and guidelines of UMS institutions compare to other regional and "best practice" institutions?

The France Center worked with representatives of the UMS and DBED to develop its research plan and strategy. The France Center's research effort consisted of a thorough review of economics and public policy literature on technology transfer, using the ECONLIT, PAIS and other databases, a review of the Association of University Technology Transfer Managers (AUTM), AUTM Licensing Survey Fiscal Year 1991 - Fiscal Year 1994 report, and conducting phone and personal interviews with technology transfer professionals in the region and around the country. The list of questions used in the interviews is included in Appendix 1.

The findings outlined in this report are the result of the research and analysis of the France Center research team. In many cases, best judgments or estimates were made, based on available research materials and the experience of the research personnel.

2.0 The Economic Impact of University Technology Transfer

The high technology sector is a critical component of the Maryland economy. High technology industries employed nearly 130,000 people in the state and accounted for 7.9% of total Maryland employment in 1993. High technology employment as a share of total private sector employment in Maryland (7.9%) is fractionally higher than the national average of 7.8%. High technology industries pay significantly higher than the state average, with high tech industries paying average weekly wages 66% greater than the private sector average wage (high tech average weekly wages of $846 compared to $508 for the private sector). Maryland's high technology sector is concentrated in information technologies, with 39.7% of total high technology employment, and high tech research, with 33.5%. High technology research is a clear area of specialization for Maryland, with Maryland's concentration of private sector high technology research employment being more than twice the national average. The performance of Maryland's high technology sector, however, has lagged the national average and Maryland lost a higher share of its high technology jobs between 1991 and 1993 than the national average.[1]

Maryland is a national leader in total, university, and federal research and development (R&D) expenditures. It is among the top five states in terms of per capita total R&D, university R&D, federally funded R&D, and federally performed R&D. The only area of R&D spending in which Maryland is not in the top five states is industrial R&D per capita, where Maryland ranked 17th. Despite having one of the highest levels of per capita R&D spending, Maryland lags the national average in commercializing technology. The number of patents issued per capita in Maryland was only 93% of the national average and Maryland was ranked 21st nationally in this measure[2].

Table 2-1
Maryland Technology Benchmarks

Item	National Per Capita	Maryland Per Capita	National Ranking
Total R&D Per Capita	$603	$1,501	5
Federally Funded Per Capita	$217	$1,281	3
Federally Performed Per Capita	$61	$809	2
University Per Capita	$76	$231	2
Industry Per Capita	$451	$419	17
Patents Issued Per 1,000 Population	230	213	21

Source: The Maryland Business Research Partnership

[1] Maryland Department of Labor Licensing and Regulation, Office of Labor Market Analysis, Maryland High Technology 1993 Update, May 1995.
[2] Maryland Business Research Partnership, Benchmarking Maryland's Business Climate and Economic Performance, forthcoming.

Promoting the development of high technology industries through technology transfer and commercialization is a central element of the state's economic development strategy. According to the *Strategic Directions for Increasing Maryland's Competitiveness* report produced by the Maryland Economic Development Commission, "Maryland's technology infrastructure represents one of the state's greatest strengths, yet this asset has not been well leveraged to support business."[3] An Action Item in the state's strategic plan aims to facilitate technology transfer from Maryland's universities and federal research facilities: "[Maryland must] enhance linkages with state educational resources and federal facilities to accelerate business development and the commercialization of technology."[4]

University research and technology transfer is a critical factor supporting the development of high technology industries. Both survey and statistically based studies of high technology company formation and employment have found the presence of a research university to be an important factor in supporting high technology development. This link was recently described by Merrick School of Business professor Zoltan Acs in an article on high technology economic development:

> "Recent statistical studies have provided evidence that economic activity responds positively to commercial spillovers from university research. High technology economic activity increases in the presence of university research undertaken within the state. Most important, spillovers are facilitated by the geographic location of university and industrial activity within the state."[5]

While the link between university research and high technology development in general is well established, there is less information on the direct economic and job creation impacts of university technology transfer. The France Center's research has identified only two studies that estimate these direct impacts. One study employs estimates of the revenue stream associated with licensed university technology to derive an estimate of both sales and employment. The other uses survey research data from the Massachusetts Institute of Technology's Technology Licensing Office to estimate the pre-production investment required to commercialize university technology. Both methodologies, however, are imprecise and in an early stage of development.

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[3] The Maryland Economic Development Commission, Strategic Directions for Increasing Maryland's Competitiveness, 1995, p.p. II-18-19.

[4] IBID., p. III-21.

[5] Acs, Zoltan, "U.S. High technology Clusters: Regional Networks in Global Webs" March 1994.

2.1 Estimates of the Sales and Employment Associated with University Technology Transfer

The Association of University Technology Managers (AUTM) has developed a methodology to estimate the private sector sales and employment associated with university technology transfer. This method is based on generally accepted estimates of the average royalty rates associated with university licenses. A consensus estimate of a royalty rate of 2% of product sales was developed in a workshop at the 1994 AUTM Conference. Total royalties are divided by this average royalty rate to derive an estimate of total sales required to support royalty payments. Total sales are then divided by a standard ratio of sales to employment in high technology industries ($125,000 in sales required to support each high technology job) developed by the U.S. Bureau of the Census to estimate total employment associated with the production and sale of licensed university technology.[6]

As demonstrated in Table 2-2, applying this methodology to 1994 licensing revenues from the AUTM Licensing Survey yields estimated sales of $13.3 billion and employment of 106,500 nationally based on currently licensed university technologies. Applying this methodology to regional technology transfer efforts yields total sales of $1 billion and nearly 8,350 jobs associated with technology licensed from institutions in the Middle Atlantic region, and $150 million in sales and nearly 1,200 jobs associated with licensed Maryland technologies. Maryland ranked 4th in the region, after Virginia, Pennsylvania, and North Carolina, with technology transferred from Maryland institutions accounting for 1% of total national sales and employment.

[6] The Association of University Technology Managers, Inc. report entitled, *AUTM Licensing Survey Fiscal Years, 1994, 1993, and 1992*, and conversations with Ashley Stevens, Community Technology Fund, Boston University, January 1996.

Table 2-2
Licensing Revenues and Their Estimated Sales and Employment Impacts
Fiscal Year 1994
(Millions of Dollars, Number of Jobs)

Item	Licensing Revenues	% of Total	Estimated Associated Sales	% of Total	Estimated Associated Employment	% of Total
Total U.S. Universities (1)	$266.2		$13,309.8		106,478	
Middle Atlantic States	$20.9	7.8%	$1,043.9	7.8%	8,351	7.8%
Delaware	$0.2	0.1%	$11.4	0.1%	91	0.1%
District of Columbia	$0.2	0.1%	$7.7	0.1%	62	0.1%
Maryland	$2.9	1.1%	$146.7	1.1%	1,174	1.1%
New Jersey	$2.8	1.1%	$140.6	1.1%	1,124	1.1%
North Carolina	$4.3	1.6%	$213.3	1.6%	1,706	1.6%
Pennsylvania	$5.0	1.9%	$248.0	1.9%	1,984	1.9%
Virginia (1)	$5.5	2.1%	$276.3	2.1%	2,210	2.1%
Best Practice States	$101.8	38.2%	$5,088.8	38.2%	40,710.5	38.2%
California	$91.1	34.2%	$4,552.8	34.2%	36,422	34.2%
Massachusetts	$10.7	4.0%	$536.0	4.0%	4,288	4.0%

Totals may not sum due to rounding

(1) Including the Center for Innovative Technology

Source: 1994 AUTM Licensing Survey, Stevens, Ashley.

The "Best Practice" states, California and Massachusetts, which have the longest history of university technology transfer, had more than $5 billion in product sales and nearly 41,000 jobs associated with university technology transfer. These two states accounted for 38% of national economic activity associated with university technology transfer.

2.2 Estimates of the Pre-Production Investment Required to Commercialize University Technology

Simply looking at the level of employment and sales associated with the production of products or services based on technology transfer underestimates the actual impact. University technologies are generally transferred at a very early stage of development. Substantial investment is required to commercialize the technology. A 1995 study of the pre-production investment associated with technologies licensed by MIT yielded two estimates of the investments required to commercialize licensed technology, one based on licensing revenues, the other based on per license averages.[7] This study relied on investment figures provided by the licensing companies through a series of interviews and surveys, and a detailed review of business plans and financial statements. This study surveyed a sample of 37 companies out of the total population of 188 companies with active, exclusive MIT licensing agreements as of early 1995. The average induced investment levels are listed in Table 2-3 and Table 2-4.

As demonstrated in Table 2-3, the MIT study estimated that start-up companies invest approximately $40 for every $1 dollar of licensing fees paid and that established small and large companies spend nearly $10.9 for every $1 dollar of licensing fees paid. The actual induced investment rates in the study for start-up companies ranged from a low of 20.6 to a high of 71.1. The actual induced investment rates in the study for small to large company licensees ranged from a low of 10.9 to a high of 14.4, excluding a value judged to be unreliable by the authors.

Table 2-3
Induced Investment Rates
Induced Investment in the Commercial Development of Licensed Technology
(Dollars Invested by Companies to Commercialize a Technology per Dollar of Licensing Revenue)

Item	Induced Investment Rate
Estimate Used for Comparison to AUTM Data	
Start-Up Companies	40.0
All Other Licensees	10.9

Source: Pressman et al, 1995

[7] Pressman, L., Gutterman, S., Abrams, I., Geist, D., "Pre-Production Investment and Jobs Induced by MIT Exclusive Patent Licenses: A Preliminary Model to Measure the Economic Impact of University Licensing" AUTM Journal, Vol. VII, pp. 49-82.

As demonstrated in Table 2-4, the MIT study estimated the average investment made to commercialize a technology license based on the type of company. Biotechnology start-up companies spent an average of $3.2 million to develop a licensed technology, start-ups in the physical sciences spent an average of $1.3 million, and other companies spent an average of $400,000.

Table 2-4
Induced Investment Rates
Induced Investment in the Commercial Development of Licensed Technology
Induced Investment per Year per License
(Millions of Dollars Invested to Commercialize a Technology per License)

Item	Induced Investment Rate
Conservative Estimate	
Biotechnology Start-Up	$3.2
Physical Sciences Start-Ups	$1.3
All Other Licensees	$0.4

Source: Pressman et al, 1995

The MIT study derives estimates of the investment and the associated employment levels associated with bringing a university technology from the lab to the marketplace. Additional investments and employment would be associated with the actual production and sale of the product and are described in Section 2.1. Not surprisingly, start-up companies need to invest more to commercialize a technology than do established small, medium or large-sized firms. Using the average investment per licensing revenues method, the MIT study estimates that start-ups spend on average $40 per dollar of licensing fees while small to large companies spend $10.9 per each per dollar of licensing fees. Using the average investment per license method, biotechnology start-ups require the highest level of pre-production investment, $3.2 million per license, and physical sciences start-ups require the second highest, $1.3 million per license, compared to an average of $400,000 for established small to large size companies. While these induced investment levels could be applied to UMS licenses to derive estimates of the total pre-production investment, the France Center lacked sufficient information to conduct this analysis at this time.

The MIT study found that nearly $1 billion in private sector investment and 2,000 jobs are directly associated with the 205 active, exclusive licenses from MIT in 1993. The authors developed estimates for AUTM of the investment and employment levels associated with university technology transfer. While there are numerous problems with extrapolating national figures from one university's experience, these were the only data available. Extrapolating the

MIT methodology to the national 1993 AUTM survey data yields an estimated level of between $2.5 billion and $5.0 billion in pre-production investment and employment of 20,000 to 40,000 associated with licensed university technology in 1993. It is important to note that this is investment prior to actual production and sale of products based on the licensed technology. It further excludes the indirect or spin-off effects of such investment of which the MIT study said, "Companies originally formed from university technology go on to invest in and manufacture other products which in turn produce income and expenditures that promote economic development at large in the surrounding community."[8]

2.3 Summary and Conclusion

University technology transfer supports economic development. Expanded technology transfer is a critical element of the state's economic development strategy and is crucial to supporting the development of high technology enterprises in the state. High technology industry is a key high wage component of the Maryland economy that depends on transferred university technology. The state is a national leader in conducting R&D but is less successful in commercializing the results of both university and federal R&D through technology transfer. Technology transfer creates investment and jobs as companies commercialize, produce, and sell products based on university inventions.

[8] IBID., p.77.

3.0 Benchmarking University Technology Transfer Effort

Benchmarking is the development of a system of measures (or benchmarks) that can be used to compare the activities of one organization to another. By comparing performance to key competitors or "best practice" organizations, an organization can identify its strengths and weaknesses as part of an ongoing system of organizational improvements. In order to develop a system of benchmarks, the process to be analyzed must first be divided into its component steps. Then performance measures must be developed for the inputs to, effort committed to, and the outcomes of the steps of the process.

Technology transfer is the process by which ideas or inventions move from a laboratory to an individual or a firm and then to the marketplace. Technologies can be transferred in many forms, both formal and informal. Informal technology transfer includes dissemination of research results through publications or conferences and the education and training of science professionals. Historically, informal technology transfer has been the central component of a university's mission to promote the advancement of knowledge and science as a public good. More recently, universities have placed an increased emphasis on the formal transfer of technology to the private sector through joint industry-university research, licensing, and the creation of start-up companies as a means of promoting both institutional advancement and economic development. This report is concerned with the formal technology transfer process.

A general description of the formal technology transfer process is as follows. The process begins with an invention or discovery through university basic research. This invention is then evaluated by the university's technology transfer office to determine its commercial potential. If further research is required, applied research can be performed at the university. Potentially interested companies are sometimes brought in during this phase to share the applied research and development costs. If the invention is ultimately determined to have commercial potential, the university may then choose to patent the technology and/or directly license the technology to an interested company. Licensing, where companies pledge payments in return for the right to use an invention, allows the university to share in the economic benefits derived by the developer of the invention. In order to promote the development of an invention by start-up companies, universities will sometimes waive licensing fees in return for an equity position in the company.

The process of university technology transfer has research inventions as the principal input to the process. Universities devote budgetary and staff resources to promote technology transfer. The outcome of the technology transfer process is the amount and value of transferred technology. The France Center has developed a system of benchmarks to measure the inputs to, resources committed to (or effort), and outcomes of the university technology transfer system.

In developing these benchmarks, the France Center drew on two prior works evaluating university technology transfer performance.[9] Modifications were made, however, to fit the

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[9] See Parker, D, and Zilberman, D., "University Technology Transfers: Impacts on Local and U.S. Economies," Contemporary Policy Issues, Vol. XI, April 1993, pp. 87-99 and The Southern Technology Council, Benchmarking University-Industry Technology Transfer in the South: 1993-1994 Data, April 3, 1995 for a description of benchmarks and measures comparing university technology transfer efforts.

requirements of this project. The France Center has derived benchmarks in the areas of technology transfer **Inputs**, **Effort**, and **Outcomes**. Input benchmarks represent the research and technologies available for transfer. The input measures chosen were patents applied for, patents awarded, and industry-sponsored research relative to total research funding. Effort benchmarks measure the resources committed to technology transfer. Three measures -- research expenditures per technology transfer staff, licenses and options executed per transfer staff, and royalties per technology transfer staff -- were derived. Outcome benchmarks measure the technology transfer outcome of the institutions. Three measures were employed: the number of licenses executed per $10 million of research, licensing royalties per dollar of research, and total number of start-up companies created since 1980 per $10 million of research.

The Jacob France Center developed these benchmarks for institutions in the University of Maryland System, key regional institutions, and several "best practice" institutions. The sample of regional and best practice institutions was derived through discussions with UMS representatives and regional and national technology transfer experts. Data for these benchmarks were taken from the AUTM Technology Transfer Survey Fiscal 1991 to Fiscal 1994 report. These data are self reported by the technology transfer offices of universities that are AUTM members.[10]

Due to time and data comparability constraints, the France Center relied on the AUTM Survey data in this analysis. As a result, this analysis is constrained by how the data were reported in this survey. There are three reporting issues that impact this analysis. The first issue is that data for the University of California System were reported for the entire state university system, while public universities from the other states in the sample chose to report individually. The second issue is that Virginia has created a state-wide technology transfer center, the Virginia Center for Innovative Technology, that works with all universities in the state to commercialize technologies. It is impossible to redistribute these activities to their source institutions. Thus, comparisons to Virginia institutions are effected and, while data for the Virginia Center for Innovative Technology are included in the report, they are not comparable to the other programs in the sample and are not included in the analysis. Finally, the third constraint is that data for the Maryland Biotechnology Institute (MBI) were reported to AUTM as part of the University of Maryland College Park (UMCP) and data for the University of Maryland, Baltimore County (UMBC) were reported with the University of Maryland at Baltimore. Insufficient data were available to include these institutions separately.[11]

3.1 Technology Transfer Inputs

The inputs to the technology transfer process are the inventions developed by each university through basic research. Because there is no widely accepted measure for what

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[10] The AUTM Technology Transfer Survey Fiscal 1991 to Fiscal 1994 collected data from a total of 159 universities, hospitals, research institutions, and patent management firms in the U.S. and Canada. The 1995 survey achieved an 84% response rate for the top 100 research universities as identified by the NSF. The survey has collected four year recurrent data on 106 institutions (80 universities) achieving 81% coverage of the top 50 research universities and 60% coverage of the top 100 research universities.

[11] In 1995, both MBI and UMBC established their own technology transfer offices.

constitutes an actual invention or new technology developed by a university, the best available measures are patent applications and patents awarded. A patent application is the first step in protecting intellectual property and consists of a formal application to the U.S. Patent and Trademark Office to establish ownership of an invention. A patent award is the formal awarding of a patent for the invention. A patent is not necessary for commercialization, but does protect the university's intellectual property rights. A third input benchmark was also employed -- industry sponsored research as a percentage of total sponsored research expenditures. This benchmark measures the university's interaction with the private sector.

3.1.1 Patent Applications

Patent applications are the first step in the protection of intellectual property. This measure can serve as a rough indicator of the level of innovation occurring at the university and the emphasis placed on disclosing and protecting research. However, this measure tracks only patents applied for, not whether the invention was worthy of or received a patent. Thus, a high value in this measure could indicate an emphasis on attempting to protect all inventions regardless of actual value. Also, a low value could represent a lack of resources to initiate the long and expensive patenting process. Finally, this measure ignores inventions that are licensed or commercialized without patent protection.

The total number of patent applications filed by the institutions in this sample in 1994 ranged from a high of 389 for the entire University of California System to a low of 14 for UMAB. Between 1991 and 1994 the total number of patent applications increased 71%. Both UMAB and UMCP reported stronger than average gains in patent applications between 1991 and 1994, with UMAB reporting the second largest increase 175%, and UMCP reporting the fourth largest, 145%.

Simply looking at the number of patent applications ignores the substantial size differences of the universities in our sample. The University of California System had $1.4 billion in sponsored research expenditures while UMAB had $118 million. In order to adjust for these size differences, the number of patent applications is divided by research expenditures to yield the number of patent applications per $10 million in research.[12] This ratio ranged from a low of .98 at UMAB to a high of 5.1 for MIT. Maryland institutions were in the low range of universities using this input measure; UMCP ranked 13th out of the sample of 16 universities and UMAB was last.

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[12] A four year moving average was used to reduce the effect of year-to-year variations. It is important to note that this method also fails to adjust for differences in research mission between different universities. Most commercializable inventions come from medical and scientific research rather than social science research. Thus, schools with a focus on medicine, science or engineering, such as MIT, would tend to have higher ratios than broad based research institutions. However, even at broad based research institutions the overwhelming share of total research expenditures are from basic or scientific research, so this effect should be relatively small.

Table 3-1
Input Measures
Total Patent Applications Filed per $10,000,000 Research,
1991-1994 Average

	4 Year Average	Rank
Total U.S. University Average	1.95	
Total Sample University Average	2.35	
MIT	5.10	1
University of Utah	3.58	2
Duke University	3.48	3
North Carolina State University	3.33	4
Univ. of Wisconsin/W.A.R.F.	2.97	5
VA Tech. Intellectual Properties	2.60	6
Univ. of Alabama / Birmingham	2.59	7
Stanford University	2.25	8
University of California System	2.13	9
Univ. VA Patents Foundation	1.68	10
Univ. NC / Chapel Hill	1.66	11
University of Michigan	1.66	12
Univ. of MD, College Park	**1.29**	**13**
Penn State University	1.13	14
Johns Hopkins University	1.12	15
Univ. of MD, Baltimore	**0.98**	**16**
VA Center for Innovative Tech.	105.66	

3.1.2 Patents Awarded

The awarding of a patent is the next step in commercializing an invention. To be awarded a patent, the invention has to be judged novel, non-obvious, and useful. This, however, does not guarantee that the invention has commercial value. Patents awarded is superior to patents applied for as an input benchmark because it represents a later stage of the commercialization process. This benchmark serves as an indicator of the level of overall innovation, tracking the number of university inventions that are judged to be advances in their field, and also measures the emphasis placed on disclosing and protecting research.

The number of patents awarded in 1994 ranged from a low of 7 patents for the University of Alabama at Birmingham to a high of 126 for the entire University of California System and 100 patents for MIT. UMCP was awarded 17 patents in 1994 and UMAB was awarded 8. As with the patent applications benchmark, patenting activity is best measured relative to total university research funding in order to adjust for size differences. Thus, the ratio of patents awarded per $10 million was derived.[13] UMS institutions were in the middle range of universities using this benchmark, with UMCP ranked 8th out of 16 institutions and UMAB ranked 10th.

[13] A moving average would be a better measure since it would adjust for year to year fluctuations, however, only data for two years were available.

Table 3-2
Input Measures
Patents Awarded per $10,000,000 Research, 1994

	Patents Awarded Per $10,000,000 Research	Rank
Total U.S. University Average	0.99	
Total Sample University Average	1.09	
MIT	2.78	1
University of Utah	1.98	2
Stanford University	1.62	3
North Carolina State University	1.53	4
Duke University	1.45	5
VA Tech. Intellectual Properties	1.35	6
Univ. of Wisconsin/W.A.R.F.	1.30	7
University of California System	0.92	8
Univ. of MD, College Park	**0.86**	**9**
University of Michigan	0.73	10
Univ. of MD, Baltimore	**0.68**	**11**
Univ. of Alabama/Birmingham	0.52	12
Penn State University	0.51	13
Univ. VA Patents Foundation	0.44	14
Johns Hopkins University	0.41	15
Univ. NC / Chapel Hill	0.34	16
VA Center for Innovative Tech.	42.37	

3.1.3 Industry Sponsored Research

Historically, universities have emphasized their traditional missions of educating students and conducting basic research. Recently, however, changes in the technology marketplace and in federal and state policies are fostering the development of a new university "paradigm" -- that of the entrepreneurial university. Under this new paradigm, universities are increasingly focusing on promoting economic development though technology commercialization, the creation of start-up companies, and joint university-industry research projects in addition to the two traditional missions.[14]

Technologies are commercialized by the private sector. As universities increase their emphasis on promoting technology transfer and economic development, linkages with the private sector are becoming increasingly important. A principal type of private sector linkage is joint university-industry research. A high level of industry sponsored research is indicative of having research projects of commercial interest and strong working relationships with the private sector. Thus, the industry sponsored research as a percentage of total sponsored research expenditures is an input benchmark measuring the level of university-industry interaction.[15]

UMS institutions were in the middle to lower range of universities in the sample, with UMAB ranked 8th and UMCP ranked 13th out of the sample of 16 universities. Industry sponsored research accounted for a total of 11% of research expenditures at UMAB and for nearly 6% at UMCP compared to a sample average of 9.7% and the U.S. average of 8%. It is also important to note that UMS institutions reported one of the strongest increases in industry sponsored research with the industry sponsored share of research at UMAB increasing fourfold since 1991 and nearly doubling at UMCP during the same period.

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[14] See Smilor, R., Dietrich, G. and Gibson, D., "The entrepreneurial university: The role of higher education in the United States in technology commercialization and economic development" International Social Sciences Journal Vol. 45, Feb. 1993, pp. 1-11, for a summary of the causes and implications of this trend.

[15] A four year moving average was used to reduce the effect of year-to-year variations.

Table 3-3
Input Measures
Percentage Industry Research,
1991-1994 Average

	4 Year Average	Rank
Total U.S. University Average	8.03%	
Total Sample University Average	10.90%	
MIT	19.48%	1
North Carolina State University	19.09%	2
Univ. VA Patents Foundation	18.09%	3
Univ. of Wisconsin/W.A.R.F.	17.47%	4
Penn State University	15.08%	5
University of Utah	13.49%	6
Duke University	11.90%	7
Univ. of MD, Baltimore	**11.20%**	**8**
VA Tech. Intellectual Properties	9.00%	9
Univ. NC / Chapel Hill	7.20%	10
University of Michigan	7.19%	11
Univ. of Alabama / Birmingham	6.49%	12
Univ. of MD, College Park	**5.85%**	**13**
University of California System	5.52%	14
Stanford University	4.76%	15
Johns Hopkins University	2.54%	16
VA Center for Innovative Tech.	100.00%	

3.2 Technology Transfer Effort

Universities commit budgetary and staff resources to promoting technology transfer. Technology transfer offices employ a mix of lawyers, scientists, and business professionals to solicit licensable technology from research personnel, evaluate the commercial potential of inventions, prepare and submit patent applications, prepare licensing agreements, receive and distribute royalty income, and monitor contracts. Technology transfer personnel generally serve as the link between the university researchers and business community.

Three benchmarks were used to evaluate technology transfer effort at Maryland, regional and best practice institutions. These were the average university research expenditure per full time equivalent (FTE) employee of each office of technology licensing (OTL), licenses and options executed per FTE of each OTL, and the average royalties per FTE of each OTL. Information on office of technology licensing budgets would have been another appropriate benchmark, however these data were unavailable.

3.2.1 Research Expenditures per OTL - Technology Transfer Staff

Staffing for university offices of technology licensing ranged from a low of .75 FTE employees at Virginia Tech to 9.6 FTE employees at MIT. The entire University of California System reported having 38.8 FTE technology transfer personnel. This benchmark measures the staff resources committed to technology transfer relative to the amount of research conducted. A low value signifies a high level of commitment, or more personnel available to assist in commercializing the results of a university's research.

The ratio of research expenditures per office of technology licensing personnel in the sample of universities ranged from one FTE per $29.5 million at UMAB to one FTE per $197.8 million at Virginia Tech. The average for the sample was one FTE per $94.9 million in research and the average for all reporting universities was one FTE per $67.2 million in research. Both of the UMS institutions reported above average resource commitments and were in the upper range of universities in the sample. UMAB reported the highest level of OTL staffing commitments and UMCP ranked 7th out of 16. Resource commitments at UMS institutions were most comparable to the best practice institutions in our sample and were generally above key regional competitors.

Table 3-4
Effort Measures
Research Expenditure per OTL - FTE, FY 1994

	Research Expenditure Mil. $ per FTE	Rank
Total U.S. University Average	$67.2	
Total Sample University Average	$94.9	
Univ. of MD, Baltimore	**$29.6**	**1**
University of California System	$35.2	2
MIT	$37.5	3
Stanford University	$41.2	4
University of Utah	$42.0	5
Univ. of Alabama/Birmingham	$44.5	6
Univ. of MD, College Park	**$49.6**	**7**
Duke University	$69.0	8
University of Michigan	$85.8	9
North Carolina State University	$104.7	10
Univ. of Wisconsin/W.A.R.F.	$130.9	11
Univ. VA Patents Foundation	$135.4	12
Penn State University	$158.3	13
Univ. NC / Chapel Hill	$173.6	14
Johns Hopkins University	$183.4	15
VA Tech. Intellectual Properties	$197.8	16
VA Center for Innovative Tech.	$5.4	

3.2.2 Licenses & Options Issued per OTL - Technology Transfer Staff

Staffing for university offices of technology licensing ranged from a low of .75 Full Time Equivalent (FTE) employees at Virginia Tech to 9.6 FTE at MIT. The entire University of California System reported having 38.8 FTE technology transfer personnel. The number of licenses and options executed per office of technology licensing personnel benchmark measures licensing activity received relative to staff resources. A high value signifies a high level of licensing activity per staff member, or a higher commitment or effort to promote technology transfer.

The ratio of licenses and options executed per office of technology licensing FTE in the sample of universities ranged from 23 licenses and options executed per FTE at the University of Virginia Patents Foundation to 1.5 licenses and options executed per FTE at UMAB. The average for the 16 university sample was 11 licenses and options executed per FTE, which was slightly higher than the AUTM Survey average of 9 licenses and options executed per FTE. UMCP was ranked 9th in this measure, while UMAB was ranked 16th.

3.2.3 Royalties Received per OTL - Technology Transfer Staff

Staffing for university offices of technology licensing ranged from a low of .75 Full Time Equivalent (FTE) employees at Virginia Tech to 9.6 FTE at MIT. The entire University of California System reported having 38.8 FTE technology transfer personnel. The royalties received per office of technology licensing personnel benchmark measures the licensing revenues received relative to the staff resources committed. A high value signifies a high level of royalty revenues per staff member, or a higher return on activities.

The ratio of royalties per office of technology licensing FTE in the sample of universities ranged from $4.6 million per FTE at the University of Virginia Patents Foundation to $69,000 per FTE at UMAB. The average for the 16 university sample was $1.25 million per FTE, which was slightly higher than the AUTM Survey average of $1.1 million per FTE. UMS institutions ranked 15th and 16th out of the 16 institutions in the sample.

Table 3-5
Effort Measures
Licenses & Options Executed per OTL - FTE, FY 1994

	Licenses & Options Executed per FTE	Rank
Total U.S. University Average	8.6	
Total Sample University Average	11.0	
VA Tech. Intellectual Properties	22.7	1
Univ. VA Patents Foundation	17.0	2
Stanford University	16.7	3
North Carolina State University	15.6	4
University of Utah	14.7	5
Johns Hopkins University	12.2	6
Univ. of Wisconsin/W.A.R.F.	11.7	7
Penn State University	11.0	8
Univ. of MD, College Park	**10.3**	**9**
Univ. of Alabama/Birmingham	8.7	10
Duke University	8.3	11
MIT	7.7	12
Univ. NC / Chapel Hill	7.3	13
University of Michigan	6.4	14
University of California System	3.6	15
Univ. of MD, Baltimore	**1.5**	**16**
VA Center for Innovative Tech.	16.0	

Table 3-6
Effort Measures
Royalties Received per OTL - FTE, FY 1994

	Royalties per FTE	Rank
Total U.S. University Average	$1,113,527	
Total Sample University Average	$1,250,882	
Univ. VA Patents Foundation	$4,635,032	1
Stanford University	$4,188,889	2
Univ. of Wisconsin/W.A.R.F.	$2,782,904	3
University of California System	$1,294,072	4
VA Tech. Intellectual Properties	$835,784	5
North Carolina State University	$652,800	6
University of Utah	$646,276	7
Johns Hopkins University	$540,682	8
Duke University	$518,721	9
MIT	$475,000	10
Univ. NC / Chapel Hill	$432,382	11
University of Michigan	$339,778	12
Univ. of Alabama/Birmingham	$267,657	13
Penn State University	$238,066	14
Univ. of MD, College Park	**$167,937**	**15**
Univ. of MD, Baltimore	**$68,532**	**16**
VA Center for Innovative Tech.	$263,159	

3.3 Technology Transfer Outcomes

The final step of the technology transfer process is when the university invention is licensed to a company for further development into a product. Evaluating the outcome of the process involves deriving benchmarks for the number of technologies licensed and the value of the licensed technology to the university and economy. Two benchmarks have traditionally been employed to measure the outcome of the technology transfer process: the number of licenses and options executed, which measures the number of technologies commercialized; and the royalties associated with licensed technologies, which measures the value of the technologies commercialized. One additional benchmark has been added in this report -- the number of start-up companies formed from transferred university technology, which measures the number of start-up companies formed based on licensed university technology.

3.3.1 Licenses and Options Executed per $10 Million in Research

The number of licenses and options executed measures the total number of commercialization agreements entered into by each university in a given year. This benchmark does not necessarily equate to actual inventions since the same technology could be licensed to several companies at the same time through non-exclusive licenses. This measure does, however, track the number of inventions licensed to the private sector. A high value in this measure indicates success in transferring university technologies to the private sector.

The total number of licenses and options executed in 1994 for the institutions in the sample ranged from a high of 74 at MIT to a low of 6 at UMAB. UMCP executed 41 licenses and options in 1994, up from 20 in 1991. In order to adjust for size differences between sample institutions, the number of licenses and options executed is divided by research expenditures to yield the number of per $10 million in research.[16] This benchmark ranged from a high of 4 licenses and options executed per $10 million in research expenditures at Stanford to a low of 0.5 licenses and options executed per $10 million in research expenditures at UMAB. The sample average was 1.45 and the AUTM survey average was 1.14. UMCP reported the third best performance in this benchmark while UMAB was ranked 16th.

[16] See Footnotes 12 and 13.

Table 3-7
Outcome Measures
Licenses and Options Executed per $10 million Research,
1991-1994 Average

	4 Year Average	Rank
Total U.S. University Average	1.14	
Total Sample University Average	1.45	
Stanford University	3.98	1
University of Utah	3.02	2
Univ. of MD, College Park	**2.29**	**3**
MIT	2.26	4
North Carolina State University	1.90	5
Univ. of Alabama/Birmingham	1.66	6
Duke University	1.55	7
University of California System	0.93	8
VA Tech. Intellectual Properties	0.91	9
Univ. of Wisconsin/W.A.R.F.	0.80	10
Univ. VA Patents Foundation	0.80	11
University of Michigan	0.71	12
Univ. NC / Chapel Hill	0.71	13
Johns Hopkins University	0.57	14
Penn State University	0.55	15
Univ. of MD, Baltimore	**0.50**	**16**
VA Center for Innovative Tech.	37.29	

3.3.2 Gross Royalties as a Percentage of Total Research Expenditures

Gross royalties are the revenues received by the university from the technologies licensed. Since most royalties are directly linked to actual or expected product sales, they reflect the market valuation of the licensed technology. Royalties include license issue fees, payments under options, annual royalty payments, termination payments, and the value of equity received when cashed-in They do not include patent reimbursement fees or a value of equity not cashed-in. Royalty levels are compared to total research expenditures to derive the royalty return on research investment figure. A high value in this benchmark signifies a higher market value of licensed technology relative to R&D expenditures, or a higher economic return on a university's R&D investment.

There is a significant amount of luck involved in technology commercialization. Certain inventions, such as the Stanford-University of California Cohen-Boyer patent yield significant revenues, while most licenses generate only a few thousand dollars. Licensing revenues can also be highly concentrated, with the most remunerative license accounting for a significant share of total revenues. The Southern Technology Council benchmarking report found that the median share of total revenues derived from the most remunerative license was 52.2% of total revenues for the 40 universities that participated in their survey.[17] This measure is inherently cumulative since most licenses are in effect for more than one year. Thus, universities with a long history of technology transfer, such as MIT, would tend to have higher returns than universities that have recently emphasized technology transfer.

Total royalties in 1994 for the 16 universities in the sample ranged from a low of $274,000 at UMAB to a high of $37.7 million for Stanford. The entire University of California System reported royalties of $50 million. Royalties as a percentage of total research expenditures ranged from a high of 9.6% at Stanford to a low of 0.15% at Penn State. UMS institutions were in the bottom range of institutions in the sample with UMCP ranked 12th and UMAB ranked 15th out of the sample of 16 institutions.

[17] The Southern Technology Council, Benchmarking University-Industry Technology Transfer in the South: 1993-1994 Data, pp. 13-14.

Table 3-8
Outcome Measures
Gross Royalties as a Percentage of Total Research,
1991-1994 Average

	4 Year Average	Rank
Total U.S. University Average	1.46%	
Total Sample University Average	1.61%	
Stanford University	9.62%	1
Univ. of Wisconsin/W.A.R.F.	3.77%	2
Univ. VA Patents Foundation	2.76%	3
University of California System	2.58%	4
MIT	1.98%	5
University of Utah	1.18%	6
North Carolina State University	0.94%	7
Duke University	0.57%	8
Univ. of Alabama/Birmingham	0.43%	9
VA Tech. Intellectual Properties	0.41%	10
University of Michigan	0.34%	11
Univ. of MD, College Park	**0.34%**	**12**
Johns Hopkins University	0.28%	13
Univ. NC / Chapel Hill	0.25%	14
Univ. of MD, Baltimore	**0.21%**	**15**
Penn State University	0.15%	16
VA Center for Innovative Tech.	5.85%	

3.3.3 Start-up Companies Formed per $10 Million in Research

University technologies are frequently commercialized by small start-up companies. Start-ups are sometimes based entirely on commercializing a specific university technology. Faculty members are frequently active in start-ups. In fact, in 1971 a University of California at Berkeley scientist created Cetus, the first biotechnology company, and the most famous biotechnology company, Genentech, was founded by a University of California at San Francisco scientist working with a venture capitalist. Start-ups are well suited to commercialize many university inventions, especially for technologies for small or niche markets that are less important to larger companies. Large companies are also frequently more interested in acquiring proven technologies that are commercialized by start-up companies than in taking a product from the laboratory to the marketplace themselves.

The formation of start-up companies is frequently beneficial to universities. Most start-ups are located close by the universities that developed the initial invention. This facilitates ongoing interaction between the university and the company. Universities can also derive significant economic benefits if a start-up in which the university holds an equity stake develops a highly successful product. A high level of start-up activity is especially important for state universities that must demonstrate economic development impacts from state funding they receive. High levels of start-up activity facilitate a higher state and local "capture rate" of the benefits of technology commercialization as inventions are commercialized locally, leading to economic and employment growth.

The AUTM Technology Transfer Survey Fiscal 1991 to Fiscal 1994 report collected information on the total number of start-up companies formed that were dependent upon licensing the university's technology.[18] Between 1980 and 1994 nearly 1,100 start-up companies have been formed nationally by universities in AUTM. A total of 356 companies were formed by the 16 universities in the sample and the Virginia Center for Innovative Technology. The total number of start-ups formed since 1980 ranged from a low of zero for the University of North Carolina at Chapel Hill to a high of 86 for MIT.

In order to adjust for size differences between sample institutions, the number of start-up companies is divided by research expenditures to yield the number of start-ups per $10 million in research.[19] This benchmark ranged from a high of 5 start-ups per $10 million in research expenditures at University of Utah[20] to a low of zero for UNC-Chapel Hill. The sample average of 1 start-up per $10 million in research expenditures was higher than the national average of 0.7 start-ups per $10 million in research expenditures. UMS

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[18] AUTM tracks companies formed. It does not ask whether these companies are still in existence.

[19] Start-up companies were compared to research expenditures between 1991 and 1994 in order to adjust for variations in research funding. It would have been better to compare start-ups to research expenditures during the 1980-94 period, however, those data were unavailable.

[20] University of Utah has aggressively targeted the formation of start-ups as a formal goal as part of the university's promotion of "academic capitalism." It is unclear whether the companies formed by University of Utah are comparable to companies formed elsewhere.

institutions were in the middle range of institutions in the sample with UMCP ranked 7th and UMAB ranked 9th out of the sample of 16 institutions. UMCP was very close to the AUTM Survey average in this measure, while UMAB lagged the average somewhat.

Table 3-9
Outcome Measures
Start-up Companies Formed FY 1980-1994
per $10,000,000 Average 1991-1994 Research Expenditures

	Start-Ups per $10 Mil. in Research Expenditures	Rank
Total U.S. University Average	0.68	
Total Sample University Average	1.09	
University of Utah	5.16	1
VA Tech. Intellectual Properties	3.38	2
MIT	2.65	3
Univ. of Alabama/Birmingham	1.28	4
Univ. VA Patents Foundation	0.80	5
Stanford University	0.90	6
Univ. of MD, College Park	**0.64**	**7**
University of Michigan	0.50	8
Univ. of MD, Baltimore	**0.48**	**9**
Penn State University	0.58	10
Duke University	0.23	11
Univ. of Wisconsin/W.A.R.F.	0.25	12
University of California System	0.22	13
North Carolina State	0.22	14
Johns Hopkins University	0.18	15
Univ. NC / Chapel Hill	0.00	16
VA Center for Innovative Tech.	71.48	

3.4 Comparison with Other Benchmarking Reports

The Southern Technology Council conducted a benchmarking study in 1995 entitled *Benchmarking University-Industry Technology Transfer in the South: 1993-1994 Data*.[21] This report collected survey data from 41 institutions (40 Universities and one Technology Transfer Center), including three Maryland Institutions -- UMCP, UMAB, and Johns Hopkins -- on seven benchmarks:

1) Patent Applications per $10 million in Research Expenditures;
2) Patent Awards per $10 million in Research Expenditures;
3) Active Licenses per $10 million in Research Expenditures;
4) Royalty Return-on-Investment;
5) Percentage of Licenses to In-State Licensees;
6) Percentage of Licenses to Start-up Licensees; and
7) Percentage of Royalties from In-State Licensees.

Three benchmarks -- Patent Applications per $10 million in Research Expenditures; Patent Awards per $10 million in Research Expenditures; and Royalty Return-on-Investment -- were used in this study as well.

The Maryland responses to the Southern Technology Council Report are included in Appendix 2. Maryland institutions[22] tended to be in the lower range of southern institutions in the report's **input benchmarks** -- Patent Applications and Patents Awarded -- and were in the third quartile of institutions in **outcome benchmarks** -- Active Licenses and Royalty Returns. The Southern Technology Council also developed three benchmarks for **economic development impacts**, In-State Licenses, Start-Up Licenses, and In-State Royalties. Two Maryland institutions provided data for the first and second economic development benchmarks and one provided data for the third. Responding Maryland institutions were in the first and third quartiles for in-state licensing, the second and third quartiles for licensing to start-ups, and the fourth quartile for in-state royalties.

In summary, Maryland institutions were ranked in the middle to lower range of southern institutions in technology transfer inputs and outcomes, but were in the middle to upper range of institutions for two key economic development benchmarks -- in-state and start-up licensing. These results are consistent with the findings of this report.

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[21] Op. Cit.

[22] The report did not reveal the results for each individual institution. It only includes information for the state-by-state results. It is, therefore, impossible to determine where each separate institution scored in these state-by-state rankings.

3.5 Summary and Conclusion

In terms of comparing UMS institutions to other institutions analyzed, UMS Institutions were in the middle to lower range of the sixteen institutions studied in technology transfer **input benchmarks**. In the area of technology transfer **effort benchmarks**, UMS institutions reported an above average level of effort to promote technology transfer, as measured by research expenditures per OTL staff, but were in the middle to lower rank of institutions in terms of office of technology licensing "throughput" as measured by licenses and options executed and royalties received per OTL staff. In terms of the **outcome benchmarks** for the technology transfer process, the results for UMS institutions were mixed. UMCP was ranked third in terms of the number of licenses and options executed while UMAB was ranked last. Both UMCP and UMAB were in the lower range of institutions in terms of royalties, or the value of transferred technologies. UMS institutions were however, in the middle range of institutions in the transferring of technology to start-up companies.

This report has four principal findings for the research question - *How does the UMS system compare to other regional and best practice institutions?* They are as follows.

1) UMS institutions are competitive within the sample of universities in terms of research inputs;
2) UMS institutions place an above average effort on promoting technology transfer;
3) UMS institutions are at the lower end of the 16 university sample in terms of the value of technologies commercialized, despite UMCP being ranked 3rd in the number of technologies commercialized;
4) UMS institutions are competitive within the sample for licensing to start-up companies.

4.0 Technology Transfer Missions, Policies and Guidelines

To answer the final research question - *How do the technology transfer policies and guidelines of the UMS institutions compare to other regional and "best practice" institutions*? - the France Center conducted a survey of technology managers at "best practice" and mid-Atlantic regional institutions. The goal of the survey was to collect information on each institution's technology transfer policies and guidelines. The survey questions asked are included in Appendix 1. Personal interviews were conducted with Maryland institutions. Out-of-state institutions were surveyed by phone. Copies of relevant program materials, policy statements, and rules and procedures were requested or downloaded from each institution's homepage on the Worldwide Web. With thorough note-taking, each interview was distilled into its most provocative points and often resulted in a follow-up call to the institution for clarification. All responding schools provided documentation in the form of written guidelines, policies and historical information about their office. A total of 13 surveys were completed. A list of the institutions surveyed is included in Table 4-1.

Table 4-1
Institutions Surveyed

Universities Participating in the Survey

University of Alabama at Birmingham
University of California at Berkeley
The Johns Hopkins University
University of Maryland at Baltimore
University of Maryland at Baltimore County
University of Maryland at College Park
University of Maryland Biotechnology Institute
Massachusetts Institute of Technology
University of Michigan
Stanford University
University of Utah
University of Virginia
University of Wisconsin at Madison

Universities That Were Contacted, But Refused to Participate

University of Arizona
Penn State University

The results of the survey and a review of program documents and materials is included in Matrix 4-1 and Matrix 4-2. Matrix 4-1 describes each participating institution's mission statement, intellectual property rules, and equity participation rules. Matrix 4-2 describes each participating institution's conflict of interest rules and financial disclosure requirements. The corresponding sections of text describe the contents and findings in each area.

4.1 Mission Statement

Mission statements can have a profound effect on the direction and intentions of university technology transfer offices. In addition, 'the mission...has an influence on directors' assessments of the advantages and disadvantages of technology transfer" and differing emphasis can lead to varying appraisals of the benefits of the office.[23] Universities that focus on a particular area of technology in their mission statement (i.e. medical, engineering) usually have more examples of success in their chosen areas. A clear mission statement that reflects the interests of the university and the office creates a sense of purpose and direction.

The France Center found that most institutions had similar mission statements, emphasizing the encouragement of research and resulting inventions, along with an open and scholarly environment where ideas can be exchanged freely. Some schools were more conservative in their statements, discussing the need to devote appropriate time to teaching and other responsibilities involving the students or service to the university. For example, the missions of the University of Virginia and UW-Madison focus on furthering the educational program and supporting the highest levels of teaching, which suggests that research, while important, is secondary. On the other hand, the University of California at Berkeley statement emphasizes that 'researchers must be free to pursue knowledge" and the policy should not be lightly abridged. This constitutes an approach on the liberal side of our sample.

The UMS schools can be placed on the more liberal side of the sample, encouraging research to aid the public interest, while also developing close ties to industry. It is the only system surveyed that mentioned regional economic development in its technology transfer mission statement.

4.2 Intellectual Property

Inventions in the university environment can occur in sponsored research programs involving industry, through general university grants and use of their facilities or federal grants. In any form, inventions that can be patented are defined by being 'new, useful, and non-obvious." Intellectual property rules govern the ownership, distribution, and commercialization rights associated with a technology in the form of intellectual property and those policies and procedures which govern the use and distribution of the technology in its tangible form. Patents are awarded by the U.S. government and it is an arduous procedure coupled with costly fees. In most cases it is beyond the means and knowledge of the inventors to successfully complete this process on their own.

The university, however, is well equipped to take on the expense and technology transfer offices acquire staff that are proficient in the patenting procedure. It becomes necessary, in nearly every case, for the inventor to relinquish ownership of his invention to the university in exchange for a share of the royalties (revenues) that accrue due to the commercial use of the patent. The tech transfer office is also able to collect funds to cover expenses through the sharing agreement while the university, the inventor's department, and school also benefit from the future royalty stream.

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[23] Coursey D. & Bozeman, "Technology Transfer in U.S. Government and University Laboratories: Advantages and Disadvantages for Participating Laboratories", IEEE Transactions on Engineering Management, Vol. 39. No. 4, November 1992, p.p. 247-351.

All survey participants, except for UW-Madison, have intellectual property policies that explicitly state university ownership of all inventions, however they are funded. This also includes inventions produced by visiting scholars and even by students.

UW-Madison was the sole survey participant not claiming ownership rights to the results of research done by faculty, staff or students. Investigators can voluntarily notify the Wisconsin Alumni Research Foundation (WARF), an adjunct agency of the university, of their invention and WARF can decide whether or not to pursue a patent.

The most important variations in these policies pertain to the distribution of royalties. After expenses are covered, royalties are distributed to several parties on a sliding scale basis. Royalties are generally shared between the inventor, the inventor's lab, the inventor's department, the School in which the lab is located, and finally the University. The distribution of royalties varies by institution. A general scheme for royalty distribution for the universities surveyed is as follows: of the first $100,000 of royalties, inventors typically receive between 15% and 50%, the lab 15% to 35%, the school 23% to 40%, the department, 10% to 35% and the University receives between 2% and 30%.

The UMS system has intellectual property guidelines similar to the majority of those schools surveyed. UM has the right to ownership of any invention resulting from activities within the scope of the inventor's employment and through the use of any type of university funds or facilities. The administrative or covering costs are slightly higher at 30% of royalties versus an average of 15% for the sample and there is a generous 50-50 split between the university and the inventor after the first $5,000 in royalties is distributed to the inventor. The university's share is then divided between the inventor's department and the office of technology development to build up funds for future patenting expenditures.

4.3 Equity Participation

The number of start-up companies which are based upon university-owned patents is growing. Whether or not faculty inventors are still fully involved in the technology, the university has the option in many cases to take an equity stake in the new firms. It is very difficult for emerging companies to obtain funds through traditional government research funding agencies or via the private capital market. Often 'this gap is met by a mix of institutional resources, novel state programs, or niche federal funds."[24] Since universities can have a vital interest in the success of a technology and its subsequent royalty stream, it is sometimes advisable for them to take an equity state in lieu of a license fee, which can be financially burdensome to a firm with little cash on hand.

All survey participants who responded to this question permitted equity positions in start-up firms. (In the case of UW-Madison, WARF could pursue the equity relationship.) The amount of the stake varied from no maximum (University of Michigan, Utah) to no larger than 10% (Stanford). Most respondents noted that historically their university accepted 5-15% equity participation in start-ups. Stanford has one of the strictest policies regarding continuing faculty involvement in the new

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[24] The Southern Technology Council, Benchmarking Best Practices for University-Industry Technology Transfer: Working with Start-up Companies, October 20, 1993, p. 19.

entity: a faculty member cannot have line management responsibilities, but may hold equity or maintain an advisory role.

The UM system has had limited experience with start-ups, but its policy is similar to the survey respondents. UMCP, for example, can take an equity position in lieu of a licensing fee up to 40%, but usually this figure is 10-20%.

4.4 Conflict of Interest

The potential for conflict of interest arises from the complex nature of the relationships and interactions which involve faculty members and universities as a whole. Faculty have many obligations: teaching, service to the university, as well as to their research and any sponsors of their research. Even personal, familial obligations can become a point of conflict. It is only recently that universities are facing this issue in a straightforward fashion.[25] In discussing conflict of interest rules in public institutions, there are even greater potential conflicts as government and the private sector become entwined and industry sponsored research expands. While many state conflict of interest policies are formulated to protect all types of employees, these same policies have the ability to constrict university research and strangle the potential for benefits to the state afforded by new technology and its commercialization.

Our survey showed that conflict of interest policies affected all faculty and staff and in 4 of 13 cases, students (paid or unpaid) were also included. Actual statements of policy varied from loose application to narrowly constricted definitions and applications. As an example of the latter, The Johns Hopkins University policy states:

> Care must be given to avoid external commitments that might threaten independent scholarly inquiry, might impair the University's reputation, compromise one's freedom of thought, compete with the University's business interests or impede the individual's ability to perform basic duties.

M.I.T. has a less restrictive conflict of interest statement. The school is primarily concerned with any adverse effects on the education provided to students or undue influence on the employment time commitment of the inventor to M.I.T. The University of Michigan is the most liberal and looks to minimize personal privacy concerns of its faculty regarding their personal financial interests as long as those obligations do not interfere with their judgment. In many cases, imbedded in the university's statement is the expectation that researchers would be forthright about any potential conflicts of interest.

The application of conflict of interest policy in most cases is through the completion of a conflict of interest disclosure form, which is reviewed by department chairs and deans. At Michigan and Utah, cases can also be reviewed by faculty committees on the subject. Respondents usually explained that their goal is to either determine that there really is no conflict, create a plan to manage the conflict, or determine that the research project cannot proceed at all. Again, M.I.T. maintains a flexible policy in this area -- a disclosure form is submitted to a department chair only. Stanford

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[25] Ibid. ,p. 21.

appears to have the most relaxed policy since faculty are on their honor to disclose any potential conflicts. At most institutions, annual updates or additional disclosure due to changing situations are mandated.

Financial disclosure is required for each "significant personal financial interest" related to a project. Significant is defined by varying measures, with the most common being anything of monetary value for the researcher and/or his immediate family exceeding $10,000 or 5% ownership in any single entity affected by the project. Stanford, however, is more liberal with a threshold of $100,000 and 0.5% equity in a company with potential conflict of interest.

The UM system conflict of interest statement is similar to the sample in its emphasis on faculty's primary commitment to teaching and the service mission of the university. However, it is more specific than any sample institution in its identification of a conflict. The policy

> is invoked when a faculty member holds an interest in an entity which has a direct interest in the outcome of sponsored research/economic development programs administered by the University or participates in such programs.

In addition, the statement makes clear the problems inherent in mixing state business with improper influences. Conflict of interest rules are applied to all faculty, full-time and part-time and some students and fellows. Like sample institutions, UMS schools require completion of disclosure forms (i.e. Routing and Approval Form, Conflict Exemption Disclosure Form, Sponsored Research and Economic Development Interest Form) which are reviewed by department chairs and deans. The forms for all approved relationships are forwarded to the State Board of Ethics. All disclosures must be updated annually or when a new situation arises. The definition of significant financial interest falls into the most common category of our sample, but includes any salary or royalties above $10,000 to the investigator in the coming twelve months. Because of the nature of a state institution, conflict of interest also arises when an employee has a financial interest in an entity that has a contract with the state or becomes an employee or officer of such an entity.

According to the Southern Technology Council's report, strict conflict of interest guidelines can have a chilling effect on technology transfer activities. In response, several institutions reported changes in state law or university confilict of interest guidelines that have led to major improvements in technology commercialization, most notably Mississippi. According to this report, 'Some programs have moved from a situation of moribund technology transfer relations with industry to active and robust programs partially as a result of careful efforts to change state law or to modify operating procedures and guidelines."[26]

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[26] Ibid. pp. 22-23.

4.5 Summary and Conclusions

A university's technology transfer office mission statement sets the tone for faculty research and should promote productivity and creativity within the institution. Intellectual property rules should allow the primary researcher to directly benefit from his work as well as support the strengths of the university. Equity participation by universities gives emerging companies the ability to get started without burdensome license fees while possibly providing an additional future revenue stream for the university. Conflict of interest rules set the standards by which the researching community can reap rewards without undermining the integrity of the institution or relationships with industry. The UM system falls within the parameters of our sample in nearly every category. However, it is important to note that many institutions and states are in the process of liberalizing their technology transfer rules and guidelines.

Matrix 4-1-- Institutional Mission Statement, Intellectual Property Rules, and Equity Participation Rules

University	University/Tech Transfer Mission Statement	Intellectual Property rules	Equity relationships
University of Alabama at Birmingham	The University encourages inventions and wants to provide every reasonable incentive to the faculty and staff so that these findings can be used for the greatest possible public benefit.	Any invention which is the result of research carried on by any employee of the University or which relates to the inventor's field of work at the University or has been developed in whole or in part by the use of resources belonging to the University, shall be assigned to the University. After deducting 15% for overhead costs plus a deduction for costs of patenting, the inventor receives 75% of accumulated royalties of $20,000 or less, 50% of royalties $100,000 or less and 30% of royalties >$100,000.	N/A
University of California at Berkeley	The teaching and research environment should continue to promote the free exchange of ideas and information among students and faculty in all of their forums. It is a principle that researchers must be free to pursue knowledge and must not be lightly abridged.	All employees, users of University facilities and those receiving gift, grant or contract funds through the University must make an agreement to assign inventions and patents to the University. Exemptions are possible. Those making the agreement shall promptly report and fully disclose the conception or reduction to practice of potentially patentable inventions to the Director of the Patent office and complete any documents necessary to assure that title shall be held by the University or parties designated by the University. Patent rights may be released to inventor when the University elects not to file a patent application or the equity of the situation indicates a release provided that no University facilities will be used to conduct further research on that invention. Will pay inventor 50% of first $100,000 of cumulative net royalties, 35% of the next $400,000 and 20% of all additional royalties.	University can take an equity position of up to 10% in any company formed. The Office of the President can affirm an equity interest up to 20% if adequately justified.
The Johns Hopkins University	The University strives to support its faculty and employees in securing commercial development of IP resulting from their research so that society benefits at the earliest opportunity.	The University has the right to obtain title to IP developed as a result of support either directly from or channeled through the University. In the absence of this support, ownership of IP remains with the inventor. Revenue distribution ranges depends on the amount (from $1000 to over $1 M) and ranges from 35% to 15% for the inventor's personal share, 30% to 25% for the inventor's lab share, 23% to 40% for the school share, 2% to 10% for the University share and a consistent 10% for the inventor's dept. share.	Any inventor's equity interest will be held in escrow by the University for the inventor. The distribution of equity revenue is: 35% as personal inventor's share 15% inventor's lab share, 10% inventor's department's share, 30% school's share and 10% university share.

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Matrix 4-1-- Institutional Mission Statement, Intellectual Property Rules, and Equity Participation Rules - Continued			
University	**University/Tech Transfer Mission Statement**	**IP rules**	**Equity relationships**
University of Maryland at Baltimore	The University strives to encourage and aid research, to provide financial compensation and professional recognition as well as best serve the public interest.	UMAB has a right to ownership of any invention resulting from activities within the scope of the inventor's employment and using any type of university funds or facilities. A 30% administrative fee is first subtracted from gross royalties. The inventor receives the next $5000 from the revenue stream and subsequent revenues are distributed 50% -50% between the university and the inventor. The university's share is divided between the department (85%); up to $100,000 and the OTD (15%) for additional patenting expenditures.	N/A
University of Maryland, Baltimore County	The Office of Technology Development serves as a gateway for business and industry to the campus with economic development for the region/state as a key objective. It evaluates, protects and markets the IP for UMBC.	Same as UMAB.	No faculty start ups yet, but incubator can take 5-6%.
University of Maryland at College Park	The Office of Technology Licensing exists to facilitate the transfer of intellectual property to business and industry through the development and management of a high quality portfolio of diverse technologies and to execute licensing agreements in order to provide benefits to the university and the economy which mirrors the general goals of the university.	Same as UMAB.	UMCP can take an equity position of up to 40%. However, it is usually a 10-20% stake in lieu of cash with a lowered royalty payoff. Usually occurs with start-ups that cannot afford entire licensing fees.
Maryland Biotech Institute	N/A	Same as UMAB.	Yes. Can take up to 45-50% maximum equity stake, but usually takes approximately 5-15%.
M.I.T.	Prompt and open dissemination of the results of MIT research and the free exchange of information among scholars. MIT is committed to excellence in education and research.	Maintains IP ownership when invention is developed by MIT faculty , students, staff, visitors or others using significant MIT funds or facilities for more than a minimal amount of time. One-third of adjusted royalty income(gross less 15% for TLO expenses and out of pocket and reserve costs) is distributed to inventors/authors.	MIT may accept an equity position in lieu of cash royalties. Must submit a Technology Disclosure Form. If an inventor holds an equity or founder's stock in a small, tightly controlled company, MIT may accept equity in lieu of royalty only with the prior approval of the VP for research and the inventor must sign a Conflict Avoidance Statement. Equity is usually less than 20% and MIT will not take a seat on a Board of Directors. Any equity obtained is transferred from the TLO to the MIT Treasurer's office.

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Matrix 4-1-- Institutional Mission Statement, Intellectual Property Rules, and Equity Participation Rules - Continued			
University	University/Tech Transfer Mission Statement	IP rules	Equity relationships
University of Michigan	The University is committed to maintaining values of openness, scientific integrity and its tradition that its members will conduct their relationships with the school with candor.	All patents and royalties that exist as a result of research by staff and supported by any funds (directly or indirectly) of the school are the property of the University. In cases involving a mix of independent activity and University supported activity, the results will be owned as agreed upon in advance. If the University decides not to license the IP it may be reassigned to the inventor. After recovery of University expenses royalties are shared as follows. First $100,000: 50% to inventor, 25% to dept., 25% to central admin. Second $100,000:40% to inventor, 30% to dept., 30% to admin. Over $200,000: 1/3 to each of the above.	Yes. There are no regulations regarding maximum equity holdings, but historically ownership is between 5-15%.
Stanford University	Individual scholars should be free to select the subject matter of their research and to seek support from any source. The University seeks to promote public good by fostering the transfer of knowledge gained through University research and scholarship to the private sector.	All patentable inventions discovered in the course of University responsibilities, with school resources, shall be disclosed on a timely basis. Title shall be assigned to Stanford regardless of any funding source. If the University cannot or decides not to proceed in a timely manner to patent the invention, it may reassign ownership to the inventors. There is a 15% deduction to cover OTL expenses and an additional deduction for patent filing fees. Stanford gives a third of the net royalties each to the inventor, the inventor's department and the inventor's school. Can accept equity as part of the license issue fee which is earmarked for the OTL Graduate Fellowship Fund.	Stanford will not acquire an equity holding greater than 10% of the company. No Stanford officer is to be a board member or officer or have a personal equity position at the time of Stanford's investment. The University will not invest in start-ups if an involved faculty member also has line management responsibilities. However, Stanford may invest in start-ups in which faculty involvement is limited to equity holdings and/or advisory roles.
University of Utah	Maintain academic freedom and promote scholarly inquiry.	The University acquires and retains title to all inventions. Will pay inventor 40% of the first $20,000 of net revenue, 35% of the next $20,000 and 30% of all additional net revenue. When economically feasible, the University also shares up to 25% of the income with the departments in which they arose to fund further research within the departments.	Assuming an inventor formed company can meet Due Diligence requirements the University will license the technology (called Academic Capitalism). The University accepts the company's stock in lieu of or combined with a reduced License Issue fee. There is no limit to the amount of equity the University can take, but historically it has not been above 10%.

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Matrix 4-1-- Institutional Mission Statement, Intellectual Property Rules, and Equity Participation Rules - Continued			
University	**University/Tech Transfer Mission Statement**	**IP rules**	**Equity relationships**
University of Virginia	Strives to support the highest levels of teaching, research and public service. The importance of maintaining objectivity in all faculty endeavors is paramount.	The University claims any invention or discovery which is judged to be the product of University research, which is defined as any use of University facilities or are related in any way to duties for which the researcher has been compensated either by or through the University. The inventor will personally receive 15% of gross royalties, license fees or other income after the UVA Alumni Patents Foundation recovers its costs. The remaining revenues vary in percentage of distribution depending on amount. Between 100% (at low revenue end) to 30% (at high end) of revenues go to inventor's research, the School receives between 0% and 40% and the Scholarly Activities Fund receives between 0% and 30%.	N/A
University of Wisconsin at Madison	The primary purpose of University research is to advance the frontiers of science and technology and further the educational program. Research should be of intellectual interest to members of the UW faculty and academic staff. It should have the promise of advancing knowledge and provide learning opportunities for students.	UW does not claim ownership rights in patents generated during research by its faculty, staff and students unless funding agreements specify ownership rights. If WARF does not take the patent assignment, once voluntarily notified, the inventor may petition a federal agency for ownership. If project is federally funded WARF must take patent ownership. WARF gives 20% of the gross income from patents to inventors and 15% of the gross to the unit where the work was performed. Any amount over $50,000/year is retained by WARF and invested to produce additional income for dept. research purposes. Does not take possession of IP. Patents are owned by WARF.	UW will not take a equity position. Private entity (WARF) can take equity position. However, since WARF is a non-profit organization it cannot engage in speculative investments without jeopardizing its tax status. Therefore, WARF can take equity in lieu of cash for licensing fees. There is no rigid policy as to the maximum amount of equity WARF can take but it usually does not exceed 10%. It cannot take equity in exchange for royalties.

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Matrix 4-2 -- Institutional Conflict of Interest Rules and Financial Disclosure Requirements

University	Conflict of Interest Statement	Applies to whom	How it is applied	Financial Disclosure Required
University of Alabama at Birmingham	A conflict of interest exists when a faculty member influences, or makes use of the University's resources or influences decisions in a way that could lead to personal financial gain or advantage to that faculty member or his/her family.	All faculty members and University employees and graduate students performing research.	It is expected that the faculty member with the assistance of the Department Chair and Dean will act to preclude or remove the conflict.	N/A
University of California at Berkeley	The purpose of the Policy is to establish a process of open disclosure and review, to identify any conflicts of interest between a researcher's project obligations and personal financial interests or obligations, and to establish a process to manage such conflict; so that financial interests of the researcher do not compromise the objectivity with projects are designed, conducted or reported.	University employees, non-employees that use University research facilities and those who receive gift, grant or contract funds through the University.	Must complete Disclosure of Financial Interests forms. To be completed annually or whenever new interests are acquired and are related to the project.	Disclosure is required for each significant personal financial interest related to a project. "Significant" means anything of monetary value for the researcher, spouse or dependent children exceeding $10,000 or 5% ownership during the prior 12 months.
The Johns Hopkins University	The policy is established as part of the University's efforts to ensure that all who act in the University's name will conduct themselves in accordance with high ethical standards. Care must be given to avoid external commitments that might impair the University's reputation, might threaten independent scholarly inquiry, might compromise one's freedom of thought or action, might compete with the University's business interests or might impair or impede the individual's ability to perform the duties of his/her University position.	All officers, faculty, staff (except APL staff) and students receiving remuneration for services.	Must prepare a written disclosure statement prior to 1) undertaking a commitment outside JHU, 2) any proposed written agreement outside JHU 3) any use of University facilities 4) when aggregate time for outside commitments exceeds established thresholds, 5) outside requirements of confidentiality that restrict public reporting of IP. Statement is then submitted to a supervisor or authorizing official for review.	An official will review disclosure information regarding proposals in which the employee will 1) receive royalties or 2) if an employee or immediate family hold equity in a potential licensee, or 3) proposals for external support of research involving an employee who holds equity (or will own equity) in a company supporting the research or a company whose technology is the subject of the research. Review is also mandatory when the employee will have a management position or any fiduciary role in any organization related to the employee's professional responsibilities.
University of Maryland at Baltimore	The University encourages the development of privately sponsored research relationships among its faculty and aims to foster economic development in the state and region in a variety of programs. However, trust is eroded when state and university business is subject to improper influence. Outside activities of a faculty member must not interfere with primary commitment of faculty to the teaching, research and service missions of the University. The Policy on Conflict of Interest is invoked when a faculty member holds an interest in an entity which has a direct interest in the outcome of sponsored research/economic development programs administered by the University or participates in such programs.	All paid and unpaid full time and part time faculty members and staff, all paid employees, students and fellows.	Investigator must complete a Proposal Routing and Approval form and, if necessary, a Conflict Exemption Disclosure Form. All disclosures must be updated during the period of the award on an annual basis or as new financial interests are obtained.	See UMBC.

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Matrix 4-2 -- Institutional Conflict of Interest Rules and Financial Disclosure Requirements - Continued

University	Conflict of Interest Statement	Applies to whom	How it is applied	Financial Disclosure Required
University of Maryland, Baltimore County	See UMAB.	All persons employed by or working under the auspices of UMBC, including part time and/or unpaid employees.	Investigator must complete a Proposal Routing and Approval form and, if necessary, a Conflict Exemption Disclosure Form. All disclosures must be updated during the period of the award on an annual basis or as new financial interests are obtained.	The dept. chair will initially review the disclosure statement and then forward it to the Dean and then to the AVP for Research for review. If COI is discovered some conditions of approval include: public disclosure, monitoring of research, modification of research plan or disqualification from participation in the portion of funded research affected. Significant financial interest is defined as an equity interest belonging to the investigator and his immediate family >$10,000 and/or ownership >5% in any single entity and any salary or royalties to the above >$10,000 during the next twelve months. COI also arises when an employee has a financial interest in an entity that has a contract with the university, becomes an employee or officer of a contracting entity with the State or when any outside activities substantially interfere with obligations to students and UMBC.
University of Maryland at College Park	See UMAB.	All personnel, faculty and staff, paid and unpaid, full-time and part-time.	Submission of Sponsored Research and Economic Development Interest Form.	The President's Advisory Committee on COI will review the Form to determine potential harm. The President must approve any exemption. Outside activities must not interfere with the primary role of teacher, researcher and service member to the University. See also UMBC.
Maryland Biotech Institute	See UMAB.	All faculty members.	Submission of the Sponsored Research and Economic Development Interest Form.	See UMCP.
M.I.T.	Any of the following factors may signify a conflict of interest: 1) an adverse impact on M.I.T.'s educational responsibility to its students, 2) an undue influence on the employment commitment of the inventor to M.I.T. in terms of time or direction of effort, and 3) a detrimental effect on M.I.T.'s obligation to serve the needs of the general public.	All MIT faculty, staff, students and others participating in MIT programs on the main campus as well as the Lincoln Laboratory. (LL is considered sponsored research staff.)	Submission of MIT Technology Disclosure Form.	Inventor must sign a Conflict Avoidance Statement affirming that he will not take direct or indirect research support from the company to support activities at MIT; will not employ students at the company and will not restrict access to information from his MIT research.

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Matrix 4-2 -- Institutional Conflict of Interest Rules and Financial Disclosure Requirements - Continued

University	Conflict of Interest Statement	Applies to whom	How it is applied	Financial Disclosure Required
University of Michigan	University faculty and staff have the right to acquire and retain personal financial interests so long as those obligations and commitments do not interfere with their duties or improperly distort the judgments expected of them. The policy fulfills external obligations for disclosure while minimizing the personal privacy concerns of researchers and their families.	All faculty and professional staff.	The principal investigator is required to submit a COI disclosure form with his proposal if he believes there is a possible COI. Disclosures that trigger state law or are above the threshold of significant financial interests will be forwarded to the COI review committee. A secondary review is conducted by a faculty committee which can allow the proposal to move ahead, require some specific administrative oversight, or recommend withdrawal of the proposal.	Equity interest cannot be greater than $10,000 in value or more than 5% aggregate (family) ownership interest in a single entity. Individual can have up to 1% equity ownership. Salary and royalties (inclusive of payments to investigator's immediate family) cannot be greater than $10,000 over a twelve month period. Principal investigator cannot be an employee, officer or director in any sponsor of project.
Stanford University	Stanford is an institution of public trust; faculty must respect that status and conduct their affairs in ways that will not compromise the integrity of the University by avoiding or minimizing conflicts of interest. They must respond appropriately when these conflicts arise. Faculty should not have their professional actions determined by considerations of personal gain.	All faculty and staff (including student employees).	The University trusts in the integrity of the faculty member to disclose any situation that could lead to real or apparent conflict of interest. Annual certification of compliance and disclosure of potentially conflicting relationships required. New situations require prompt ad hoc disclosure.	The threshold for significant financial interest is $100,000 or 0.5% equity of a company in which COI is possible. Faculty must disclose whether they (or an immediate family member) have consulting or employment arrangements in an outside entity before the University will approve gifts, sponsored projects, or tech licensing agreements between the entities and Stanford. Disclose information about financial relationships with sponsors of teaching or research programs.
University of Utah	The University recognizes that many potential conflicts of interest do not constitute actual conflicts or are acceptable with proper oversight and safeguards. To avoid even the appearance of impropriety, this policy requires disclosure of all situations involving University employees identified as possible conflicts of interest.	All University employees.	Completion of a Purchasing Conflicts of Interest form and a request in writing explaining all pertinent circumstances to the dean and department chair. Approval is forwarded to the designated VP who has authority to approve, disapprove or approve with condition. Can be referred to COI Advisory committee.	Disclosure mandatory only in case of "acceptable under some conditions". If there is participation or assistance by an employee or immediate family member in which there is significant financial interest approval is required. The amount of a nonpecuniary gift under current state laws is $50.

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Matrix 4-2 -- Institutional Conflict of Interest Rules and Financial Disclosure Requirements - Continued

University	Conflict of Interest Statement	Applies to whom	How it is applied	Financial Disclosure Required
University of Virginia	Employees should disclose actual or potential conflict of interests and should not initiate any contract or transaction to which the University is a party until approval is received from the Assistant Vice President and University Comptroller.	All faculty, staff and officers.	Incorporating state laws, university policy demands that investigators submitting proposals identify significant financial interest that might appear to affected by the project.	Investigators provide a notice of any significant financial interest to their dept. chair. If it is determined that COI exists, then the chair will develop a plan to manage the conflict which is forwarded to the Vice Provost for Research who maintains a standing COI committee. Significant financial interests include: an equity interest >$10,000 in value; salary or royalties to researcher and immediate family over the next year >$10,000; and ownership interest in a business which exceeds 3% of the equity of the firm.
University of Wisconsin at Madison	N/A	All faculty , students and staff.	All faculty and staff must file annually a UW-System Faculty and Academic Staff Report on Outside Activities and Interests.	All faculty or staff applying for or receiving federal funds must submit an UW-Madison Investigators Financial Disclosure Form on Federal Projects. COI occurs when faculty or staff (or an immediate family member) receive more than $10,000 per year from a single for profit business for activities related to the staff member's academic interests or own more than 5% of a same such business.

Appendix 1
Technology Transfer Survey

PERSONAL INTERVIEW GUIDE

Section 1: Research Inputs

1a) What is the total research budget for your university and for the entire university system of which you are part?

1b) Can you provide a list of grant revenues by major granting agency for the past 3-5 years?

Technology Commercialization Process
-- Policies and Guidelines

2) What are your University's Conflict of Interest Guidelines? Can you provide a copy of the Guidelines?

3) What are your University's Intellectual Property Rules? Can you provide a copy of the Guidelines?

4) What are your University's Guidelines for researcher/faculty participation in privately sponsored research? ? Can you provide a copy of the Guidelines?

5) Can your University take an equity position in any company formed through your commercialization process? ? Can you provide a copy of the Guidelines?

6a) Are your activities restricted by state laws regarding technology transfer or commercialization? If yes, can you provide a copy of the relevant laws? (For state schools)

6b) If yes, when were these laws last revised? Why were they revised? Who suggested the revisions? What has been the impact of the revisions?

Technology Commercialization Process
--Programs and Structures

7a) Does your university have a technology transfer office?
7b) If yes, What is its staff _____?, What is its budget_____?, What number of deals does it handle each year _____?,

8a) Does your university have a small business incubator?
8b) If yes, What is its staff _____?, What is its budget _____?, How many companies operate in the facility _____?,

9a) Does your university have a venture capital program?
9b) If yes, What is its staff _____?, What is its budget _____?, What is its level of capitalization _____? How many investments did the program make in each of the past 3-5 years ___?

10a) Does your university have any joint Industry-University Research Programs?
10b) If yes, How many does you university have _____? What is its staff _____?, What is its budget _____?, How many companies participate _____? in each of the centers?

Please provide any materials describing any of the above listed programs> We are especially interested in any evaluation materials you may have on each or any of the programs

Commercialization Outputs

11) How many patents was your university awarded in each of the past 3-5 years (by year) ?

12) What was total licensing revenues for your university in each of the past 3-5 years (by year) ?

13) What was total royalty revenues for your university in each of the past 3-5 years (by year)?

14) What was total revenue from industry-university research agreements for your university in each of the past 3-5 years (by year) ?

15) How many companies have started-up as a result of your commercialization programs __?
How many are located in-state____ ?
What is the approximate employment level for each _____?
What is the approximate sales level for each _____?
What is the approximate R&D level for each _____?
Do these firms continue to work with the university in some manner continue to work with the university in some manner ____?

Appendix 2
Maryland State Performance

State Performance • Maryland

	First Quartile	Second Quartile	Third Quartile	Fourth Quartile
Measure I-A Patent Applications per $10 Million Expenditure				
Measure I-B Patents Awarded per $10 Million Expenditure				
Measure II-A Active Licenses per $10 Million Expenditure				
Measure II-B Royalty Return-On-Investment				
Measure III-A Percentage of Licenses to In-State Licensees				
Measure III-B Percentage of Licenses to Start-Up Licensees				
Measure III-C Percentage of Royalties From In-State Licensees				

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